

REPORT ON THE CONSERVATION STATUS OF
ARABIS FECUNDA, A POTENTIAL CANDIDATE SPECIES

Taxon name: Arabis fecunda Rollins
Common name: Sapphire rockcress
Family: Brassicacae (cruciferae)
State (s) where taxon occurs: Montana
Current federal status: None
Recommended Federal Status: U.S. Fish and Wildlife Service
Category 2
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Original Date of report: November 15, 1985
Date of most recent revision:
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I. Species Information**1. Classification and Nomenclature****A. Species****1. Scientific name**

- a. Binomial -- Arabis fecunda Rollins
- b. Full bibliographic citation -- Contributions from the Gray Herbarium 214:1. 1984.
- c. Type specimen(s) -- Montana. Ravalli County: on rocky terrain near sagebrush, big game range east of Corvallis, June 13, 1976, Jaculyn Cory 1611, MONTU. Isotype in private collection of J. Cory, Hamilton, MT

2. Pertinent synonyms -- None**3. Common names -- This newly described species has no established vernacular name; however, the names Sapphire Rockcress and Bitterroot Rockcress have been applied to this species.****4. Taxon codes -- None****5. Size of genus -- Over one hundred species throughout the Northern Hemisphere (Hitchcock et al. 1964)****B. Family classification****1. Family name -- Brassicaceae****2. Pertinent synonym(s) --Cruciferae****3. Common name of family -- Mustard Family****C. Major plant group -- Dicot****D. History of knowledge of taxon -- Arabis fecunda was first collected by Jaculyn Cory at the type locality in mid-May, 1975 (Cory 1416). These specimens were in flower, and she returned in mid-June of 1976 to collect the type specimen in fruit. The identification of these specimens remained undetermined until 1983 when they were sent to Reed C. Rollins at Gray Herbarium who described them as a new species.****E. Comments on current alternative taxonomic treatments -- there are no alternative taxonomic treatments.**

2. Present legal or other formal status

A. International -- None

B. National -- No current federal status

C. State

1. Montana

a. Present designated or proposed legal protection or regulation -- None

b. Other current formal status recommendations -- Considered critically endangered by the Montana -Wyoming office of The Nature Conservancy.

3. Description

A. General nontechnical description -- Arabis fecunda is a small perennial forb with one to many clusters of basal leaves and flower stalks 3-12" high. The basal leaves generally have a smooth margin and are 1/2-1" long and about 1/8" wide. The leaves on the flowering stalk are smaller and clasp the stem. The leaves and the stem are greyish white with a dense cover of small branched hairs. The flower stalks are unbranched and most of the length is given over to flower and fruit production (hence the specific name, fecunda). Each flower has four white petals 1/4-1/2" long and about 1/8" wide. The flowers are close together on the stalk but become further apart as they mature into fruits. The fruits are 1-2" long and about 1/20" wide and held nearly erect by the pedicels which become up to 1/2" long. The fruits are densely hairy and each side of the fruit contains a single row of round seeds about 1/20" in diameter.

B. Technical description -- Perennial with a simple or branched caudex, densely pubescent throughout with fine dendritically branched trichomes; stems erect to somewhat decumbent at base, simple or few branched, 1-3 dm high; leaves hoary, dimorphic; basal leaves petiolate, spatulate to linear lanceolate, entire or with a few broad teeth in the blade area, 1-3 cm long, 2-4 mm wide; cauline leaves sessile, entire or the lower with a few teeth, oblong, acute, sparingly auriculate to onoauriculate, 7-20 mm long; inflorescences usually congested; sepals oblong, nonsaccate, densely pubescent, 6-7 mm long, ca. 2mm wide; petals white often drying purplish, obovate, not unguiculate, narrowing gradually from blade to point of insertion, 9-13 mm long, 3-5 mm wide; fruiting pedicels erect to slightly divaricately ascending, straight, 6-10 mm long; siliques erect, congested, usually appressed to rachis, straight to slightly curved inward, 3-5 cm long, ca. 1.5 mm wide, valves densely pubescent, compressed between seeds; styles ca. 1 mm long; seeds in a single row, suborbicular to slightly longer than broad, narrowly wing-margined all around, qc. 1.2 mm in diameter, mucilaginous when wetted; cotyledons accumbent (Rollins 1984).

- C. Local field characters - Arabis is a very difficult genus, and a suite of characters is usually needed to distinguish any one species from all others. The very erect fruits and the dense greyish vesture of branched hairs on the foliage and fruit distinguish A. fecunda from all other Arabis found in western Montana. To date, this species has been found only in eroding light-colored soils associated with rock outcrops.
- D. Identifying characteristics of material which is in interstate or international trade or commerce -- None known
- E. Photographs and/or line drawings -- Line drawings are not available. Color photographs are available from the slide collection of the Montana-Wyoming Field Office of The Nature Conservancy, Helena, Montana.

4. Significance

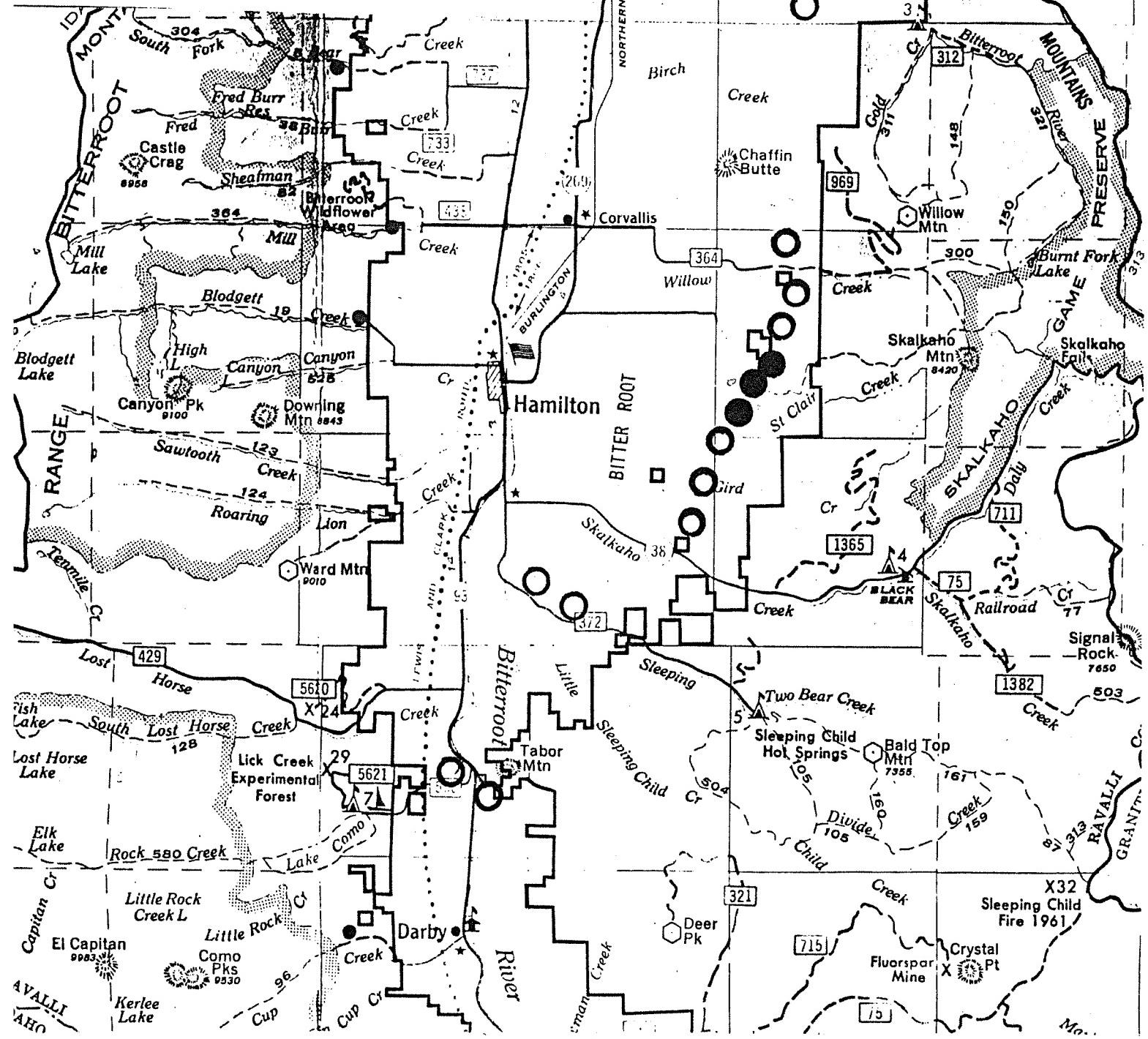
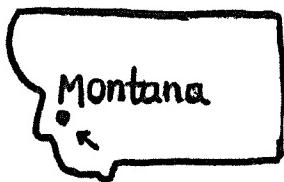
- A. Natural -- At this time A. fecunda appears to be an example of very narrow edaphic endemism. There are no sympatric closely related species.
- B. Human -- Human significance is unknown.

5. Geographical Distribution

- A. Geographical range -- known from elevations of 4,600-5,000' (1430-1525 m) at the heads of three tertiary drainages in the foothills of the Sapphire Mountains east of Hamilton in Ravalli County, Montana.
- B. Precise occurrences
 - 1. Populations currently known extant (see Fig. 1):
 - a. Charley's Gulch (Montana, Ravalli Co., S1/2 Sec 19, W1/2 Sec 20, NW 1/4 Sec 29, NW 1/4 Sec 30 T 6N R19W; U.S.G.S. 7.5 minute Corvallis and Willow Mtn.) This site is the type locality for the species and consists of approximately six populations with a total of approximately 1000 individuals.
 - b. Spring Gulch (Montana, Ravalli Co., SW 1/4 Sec 30, NW 1/4 Sec 31 T6N R19W; U.S.G.S. 7.5 minute Mountain House) This site consists of two populations and approximately 200-500 individuals.

Fig. 1 Area searched for *Arabis* *fecunda* in 1985.

- Areas searched unsuccessfully
- Populations of *A. fecunda*



- c. Rock Quarry Gulch (Montana, Ravalli Co., SW 1/4 Sec 31 T6N R19W; U.S.G.S. 7.5 minute Mountain House) This site consists of one population of approximately 200-300 individuals.
 - 2. Populations known or assumed extirpated: None known
 - 3. Historically known populations where current status is unknown: None
 - 4. Locations not yet investigated believed likely to support other possibly extant natural occurrences: Areas of calcareous rock outcrops above 6000' in the Sapphire Mountains should be investigated.
 - 5. Reports having ambiguous or incomplete locality information: None.
 - 6. Locations known or suspected to be erroneous reports: None known.
- C. Status and location of presently cultivated material -- No cultivated material known.
- D. Biogeographical and Phylogenetic history -- The relationship between A. fecunda and other species of Arabis is obscure. Rollins (1984) considers A. fernaldiana, A. shocklegi, A. puberula, A. pulchra and A. subpinatifida to be possibly closely related to A. fecunda, but he is careful not to make any definitive statements. Of these species, only A. puberula is found in the Pacific Northwest.
6. General environment and habitat description
- A. Concise statement of general environment and habitat -- Sandy light-colored, highly calcareous soils with moderate to large amounts of coarse fragments derived from metamorphosed calc-silicate parent materials. Sites are generally on steep eroding slopes above drainageways in the sagebrush-grassland zone between 4700 and 5000'. Sites are frequently associated with outcroppings of parent material. Scattered Pseudotsuga menziesii and Pinus ponderosa are often present. Vegetation of these sites is sparse and distinctive in relation to surrounding areas.
- B. Physical characteristics
1. Climate
- a. Koppen Climate Classification -- Unknown
 - b. Regional macroclimate -- For Hamilton, approximately 5 mi west and 1000 ft. lower than the population sites, July mean is 67.9°F, January mean is 24.1°F, and average annual precipitation is 12.74 in. (Anon 1964).

- c. **Local microclimate** -- No quantitative information is available; however, A. fecunda generally occurs on slopes with warm aspects and high soil albedo which would result in a warm to hot microclimate.
2. **Air and water quality requirements** -- Not known.
3. **Physiographic province** -- mapped as part of the Northern Rocky Mountain Province by Hunt (1967).
4. **Physiographic and topographic characteristics** -- All known sites occur in an area along the west slope of the Sapphire Mountains mapped as a calc-silicate unit of the Wallace Formation and are just south of a large granitic intrusion, the Willow Creek Stock (Presley 1971). The sites are on steep eroding slopes near the heads of tertiary drainages which feed Willow Creek which, in turn, is a tributary of the Bitterroot River. All known sites occur from 4,600-5,000 ft. in elevation.
5. **Edaphic factors** -- The soils at the known sites are sandy in texture, light-colored and highly calcareous (see Table 1). Soils appear to be derived from highly metamorphosed calc-silicate rock (D. Alt, Geology Dept., University of Montana, personal communication). These soils have a very low organic matter content and are near-neutral in reaction. Soils are very unusual for western Montana.
6. **Dependence on dynamic aspects** -- Arabis fecunda is found only in fairly open soil associated with steep eroding slopes. Erosion of the slopes undoubtedly contributes to the maintenance of this species habitat.
7. **Other unusual physical features of environment and habitat**
-- None.

(7)

TABLE 1. Analysis of soil from Charley's Gulch site (NW 1/4 Sec 29 T6N R19W). Analysis was performed by the Soils Lab, School of Forestry, University of Montana. Percent organic matter was determined by loss on ignition (Chapman 1976). Percent sand, silt and clay were determined by the Bouyoucous hydrometer method (Chapman 1976). Elemental analysis was performed with a Jarrell-Ash 865 inductively-coupled plasma spectrometer on extracts obtained with four 25 mil aliquots of 0.5N ammonium acetate on a 2g sample.

PH	7.4
% organic matter	1.0
% sand	65
% silt	32
% clay	3
AL	5.1 ppm
B	0.6 ppm
Ca	12,780 ppm
Cu	0.61 ppm
Fe	8.9 ppm
Mg	44.0 ppm
Mn	6.18 ppm
P	30.3 ppm
K	11.0 ppm
Si	26.4 ppm
Na	6.0 ppm

C. Biological characteristics

1. Vegetation, physiognomy and community structure - An open lithosol community-type dominated by perennial forb species. There are often a few trees (Pseudotsuga menziesii and Pinus ponderosa) associated with these sites, but for the most part, they are open and exposed.
2. Regional vegetation type - Mapped as Foothills Prairie by Kuchler (1964); this area better fits his description of Sagebrush Steppe. Mapped as Foothills Prairie by Weaver (1980).
3. Frequently associated species - Artemisia frigida, Koelaria cristata, Chrysopsis villosa, Gilia spicata, Physaria geyeri and Haplopappus armerioides are common native species found with Arabis fecunda. Common introduced species are Centaurea maculosa, Allysum allysoides and Bromus tectorum.
4. Dominance and frequency - Only at one of the subunits of the Charley's Gulch site is Arabis fecunda a codominant. Generally A. fecunda accounts for less than 20% of the total plant cover at the sites.
5. Successional phenomena - Arabis fecunda persists only in what might be considered areas indefinitely held in an early stage of primary succession.
6. Dependence on dynamic biotic features - Unknown.
7. Other endangered species - None.

7. Population biology

- A. General Summary - Populations generally consist of approximately 50-300 plants. There are nine populations in three tertiary drainages, all within a radius of 1.5 miles. At each site 30-50% of the individuals were non-flowering. A large portion of these are probably juveniles indicating reasonable reproductive success. Most reproductive individuals appeared to have mature fruit. Since this species blooms quite early, it is probably facultatively autogamous (self-fertilizing).

B. Demography

1. Known populations - Nine populations of Arabis fecunda are known, all within a 1 1/2 mile radius of the head of Spring Gulch. Field studies in 1985 indicate the total number of individuals to be 1000-2000.

2. Demographic details

a. Charley's Gulch:

1. Area - Six populations spread over ca. 1 mi². Total area occupied by A. fecunda is ca. 2-3 acres.
2. Number and size of plants - ca. 1000 plants; ca. 30% were non-reproductive in 1985.
3. Density - The one largest population is fairly dense (greater than 20% total plant cover), otherwise plants are scattered.
4. Presence of dispersed seed - Unknown.
5. Evidence of reproduction - Presence of mature fruit and small non-flowering plants.
6. Evidence of expansion/contraction - None.

b. Spring Gulch

1. Area - Two populations in an area of approximately 1/2 mi². Total area occupied by A. fecunda is ca. 2-3 acres.
2. Number and size of plants - ca. 200-500 plants; ca. 50% were non-flowering in 1985.
3. Density - Scattered.
4. Presence of dispersed seed - Unknown.
5. Evidence of reproduction - Presence of mature fruit and small non-reproductive plants.
6. Evidence of expansion/contraction - None.

c. Rocky Quarry Gulch

1. Area - One population occupying ca. 10-15 acres.
2. Number and size of plants - ca. 200 plants; ca. 30% were non-flowering in 1985.
3. Density - Scattered.
4. Presence of dispersed seed - Unknown.
5. Evidence of reproduction - Presence of mature fruit and small non-flowering plants.
6. Evidence of expansion/contraction - None.

C. Phenology

1. Patterns - Arabis fecunda begins to bloom in early to mid-June. Mature fruit is present from late May on.
2. Relation to climate and microclimate - Plants on warmer slopes begin development earlier.

D. Reproductive ecology

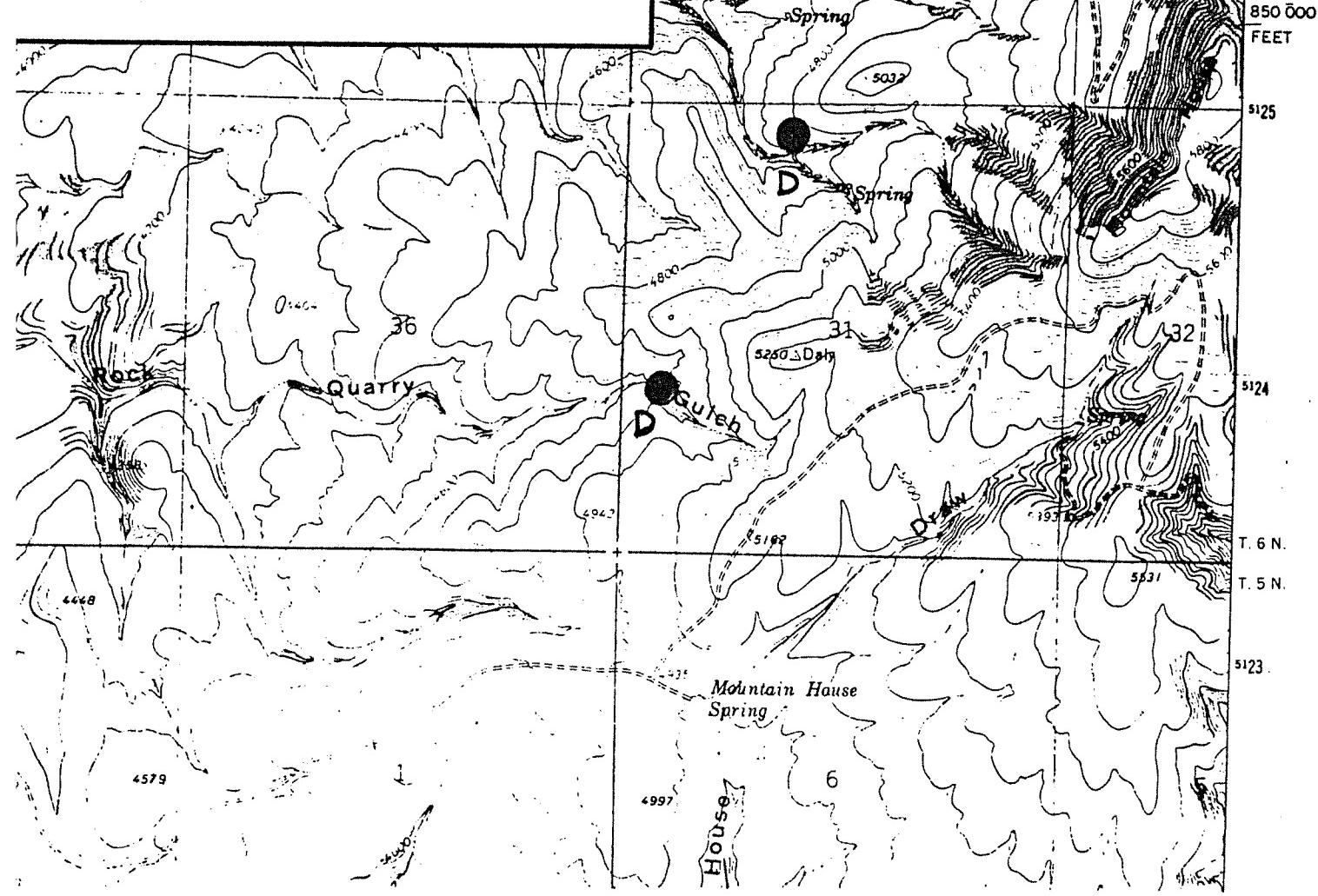
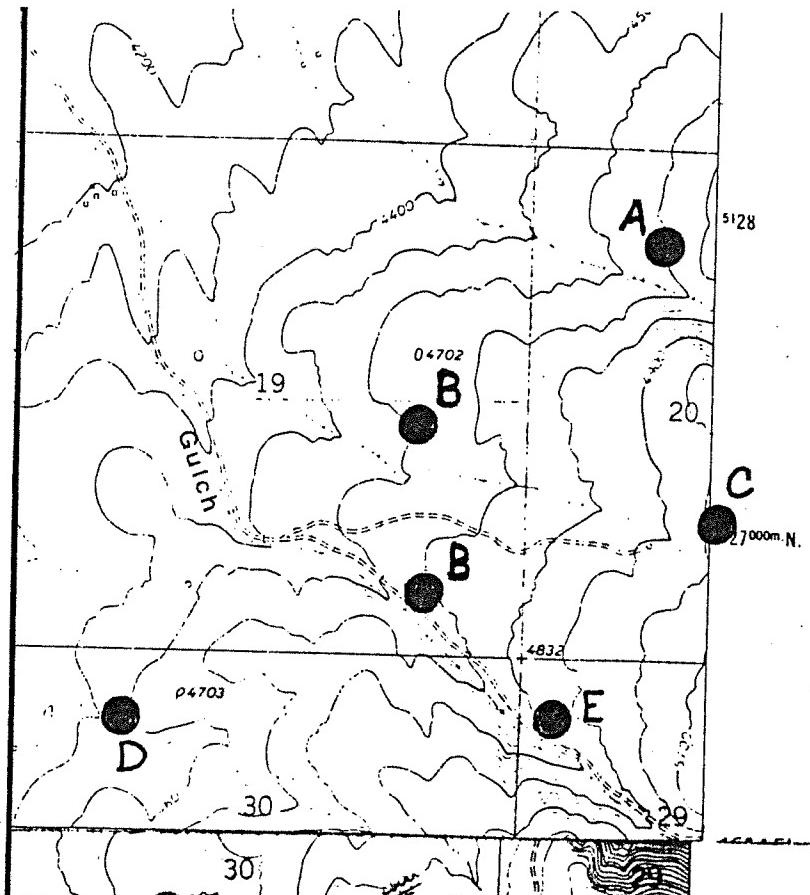
1. Types of reproduction - Although individual plants grow larger by growth and branching of the caudex, true reproduction is only by seed. Details of the breeding system are unknown; however, because A. fecunda blooms so early, it is probably at least facultatively autogamous.

2. **Pollination**
 - a. **Mechanisms** - Unknown, probably by selfing and by insects.
 - b. **Specific known pollinators** - None known.
 - c. **Other suspected pollinators** - Early in the spring flies are often the most common pollinators.
 - d. **Vulnerability of pollinators** - Unknown.
3. **Seed dispersal**
 - a. **General mechanism** - Although not directly observed, dispersal of the seeds of A. fecunda is probably similar to that of other species of Arabis. Valves of the siliques open from the tip downwards which expose the seeds which drop or are shaken to the ground. Seeds are narrowly wing-margined, a trait which may aid in wind-dispersal.
 - b. **Specific agents** - Unknown.
 - c. **Responses of mechanisms** - Unknown.
 - d. **Dispersal patterns** - Unknown.
4. **Seed**
 - a. **Amount of seed production** - Approximately 50-1500 seeds are produced by each reproductive plant.
 - b. **Seed viability and longevity** -Unknown.
 - c. **Dormancy** - Unknown.
 - d. **Germination requirements** - Unknown.
5. **Seedling ecology** - Small non-reproductive rosettes of A. fecunda, presumed to be seedlings or juvenile plants, are fairly common in most populations. They are most common where vegetation cover is lowest.
6. **Survival and mortality** - No information.
7. **Overall assessment of reproductive success** - Population trends are unknown, but seed production appears to be sufficient to maintain population numbers, and the presence of a significant number of presumed juveniles indicates that reproduction is successful.
8. **Population ecology**
 - A. **General summary** - Arabis fecunda occurs on an unusual soil type in very sparse azonal vegetation. These sites are being rapidly invaded by the aggressive introduced weed, Centaurea maculosa (spotted knapweed).
 - B. **Positive and neutral interaction** - None known.
 - C. **Negative interaction**
 1. **Herbivores, predators, pests, parasites and diseases** - A rust (Puccinia sp.) was observed infecting a small number of plants at the Charley's Gulch site.

2. Competition
 - a. Intraspecific - Most populations are too sparse for intraspecific competition to be a factor.
 - b. Interspecific - Usurpation of habitat by Centaurea maculosa is the single most serious threat to the continued existence of Arabis fecunda. Centaurea is the most serious agricultural pest in Ravalli Co. Its ability to invade and replace native plants is well-documented (Morris and Bedunah 1984, Harris and Cranston 1979). Many of the sites where Arabis fecunda occurs already have serious infestations of Centaurea.
3. Toxic and allelopathic interactions - Some researchers feel that Centaurea maculosa produces allelopathic substances (Fletcher and Renney 1963). If so, then C. maculosa is not only occupying A. fecunda's habitat but is actively poisoning this rare local endemic.
- D. Hybridization
 1. Naturally occurring - Arabis nuttallii and A. holboellii occur in the zonal sagebrush-grassland vegetation, but no evidence of hybridization was observed.
 2. Artificially induced - None known.
 3. Potential in cultivation - Unknown.
- E. Other factors of population ecology - None known.
9. Current land ownership and management responsibility
 - A. General nature of ownership - Private landowners and State of Montana
 - B. Specific landowners - See Fig. 2.
 - C. Management responsibility - Same as ownership except state land is leased. Lessee is unknown.
 - D. Easements, conservation restrictions etc. - None known.
10. Management practices and experience
 - A. Habitat management
 1. Review of past management and land-use experiences
 - a. Arabis fecunda - No experience.
 - b. Related taxa - No experience.
 2. Performance under changed conditions - In Charley's Gulch, there is a roadcut through the soil type usually occupied by A. fecunda. A few plants of A. fecunda occur in the open soil of this roadcut, but, in general, it seems unable to invade man-made disturbed areas.

Fig. 2 Location of populations of *Arabis fecunda* and land ownership.

- A. Brian Weber
1183 NE Hamilton Hgts.
Corvallis, MT 59828
- B. George & Marilyn Frost
1112 NE Hamilton Hgts.
Corvallis, MT 59828
- C. Ruth Rasmussen
506 S. 8th Street
Hamilton, MT 59840
- D. Bitterroot Stock Farm
P. O. Box 271
Hamilton, MT 59840
- E. State of Montana



3. **Current management policies and actions** - All known sites occupied by A. fecunda are grazed by cattle. Cattle are probably instrumental in introducing the seeds of Centaurea maculosa into A. fecunda sites. The largest known population occurs along a gravel road in Charley's Gulch.
4. **Future land use** - Human habitation of the Bitterroot Valley has increased dramatically for the past 20 years. If the area is not subdivided, it will probably continue to be used for livestock.

B. **Cultivation**

1. **Controlled propagation techniques** - No information.
2. **Ease of transplanting** - No experience.
3. **Pertinent horticultural knowledge** - None.
4. **Status and location of presently cultivated material** - None known.

11. **Evidence of threats to survival**

A. **Present or threatened destruction, modification, or curtailment of habitat or range.**

1. **Past threats** - Livestock grazing has resulted in the spread of Centaurea maculosa into the area and probably onto the sites occupied by A. fecunda. Construction of the road up Charley's Gulch may have destroyed some habitat.
2. **Existing threats** - A very serious threat to the continued existence of Arabis fecunda is the rapid usurpation of its habitat by Centaurea maculosa. C. maculosa is a pernicious weed which has already succeeded in nearly replacing native grasses from the surrounding grasslands. Trampling of soil and erosion at A. fecunda sites by cattle may or may not be a threat.
3. **Potential threats** - Broadcast herbicide application may become a threat, although at this time it is probably not feasible. Subdivision of the area into residential tracts and the concurrent increase in human use of the area is a very real and serious threat. The possibility of impacts from prospecting or mineral development needs further investigation.

B. **Over-utilization for commercial, sporting, scientific or educational use** - No threats known.

C. **Disease, predation or grazing** - The plants are not significantly grazed by cattle. Domestic sheep, if introduced into the area, might constitute a threat. Threats from disease or predation do not appear to be significant.

D. **Inadequacy of existing regulatory mechanisms** - None known.

E. Other natural or man-made factors

1. Past threats - Not known.
2. Existing threats - The small total area of suitable habitat limits A. fecunda to a relatively small population size. Small numbers of individuals increases the risk of extirpation and loss of genetic variability.

II. Summary and Recommendations

12. General assessment of vigor, trends and status - Arabis fecunda appears to be confined to a small number of populations in a restricted area. The continued existence of this species is seriously threatened by encroachment on the habitat by Centaurea maculosa (Spotted knapweed). This aggressive weed may well be able to greatly reduce or eliminate A. fecunda from its native habitat. Most of the sites which support populations of A. fecunda have already been invaded by C. maculosa. Sites with large numbers of C. maculosa generally support only small populations of A. fecunda. Reproductive output and vigor of A. fecunda appear to be normal.

13. Priority of listing or status change

A. Recommendation to U.S. Fish and Wildlife Service - On the basis of the evidence presented here, I recommend to the U.S. Fish and Wildlife Service that the plant species Arabis fecunda be listed as category 2 under the provisions of the Endangered Species Act of 1973.

B. Recommendation to other U.S. federal agencies

1. U.S. Forest Service - Although A. fecunda is currently not known to occur on lands administered by the U.S. Forest Service, known populations are close to Bitterroot National Forest lands and populations may be discovered on F.S. lands. I recommend to U.S. Forest Service Region One that Arabis fecunda be placed on the list of sensitive species.

C. Other status recommendations

1. State - A. fecunda should be listed as endangered in Montana.
2. Other nations - Not pertinent.
3. International - Not pertinent.

14. Recommended critical habitat

A. Legal description of boundaries - Due to the threat from invasion by exotic weeds, large ungrazed areas around the populations should be maintained as buffer zones. The area which includes all known populations and buffer zones is W 1/2 Sec 20, E 1/2 Sec 19, NW 1/4 Sec 29, W 1/2 Sec 30, W 1/2 Sec 31, T6N R19W.

B. Publicity - sensitivity of critical habitat area - The area of proposed critical habitat is of unknown publicity sensitivity; however, publication of exact population locations should be avoided to prevent collecting and vandalism.

15. Conservation/recovery recommendations

A. General conservation recommendations

1. Recommendations regarding present or anticipated activities - Any road-improvements along the Charley's Gulch road in sections 19 and 29 and any broadcast herbicide spraying in the critical area should be curtailed.
2. Areas recommended for protection - All known populations of A. fecunda should be protected. The sites in sections 20 and 29 are the largest and deserve primary attention.
3. Habitat management recommendations - All livestock grazing in critical habitat areas should be curtailed. Biological control vectors for Centaurea maculosa should be introduced (Story and Nowierski 1984, Maddox 1979).

B. Monitoring activities and further studies recommended

1. Populations of Arabis fecunda and co-occurring populations of Centaurea maculosa should be monitored in order to determine population trends for both of these species and to document trends in replacement of A. fecunda by C. maculosa.
2. Techniques for eradicating C. maculosa from sites harboring populations of A. fecunda should be developed.

16. Interested parties:

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III. Information Sources

17. Sources of information

- A. Publications - Rollins (1984).
- B. Museum collections consulted - specimens of all known collections are housed at the herbarium at the University of Montana (MONTU) Recent collections by the author will be deposited at MONTU, MONT, NY and GH.
- C. Field work - All populations described in this report were visited by the author in May 1985.
- D. Knowledgeable individuals -

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- E. Other information sources - A collection of color slides of A. fecunda and its habitat at the various sites as well as detailed information on these sites is on file at the Montana/Wyoming Office of The Nature Conservancy, P.O. Box 258, Helena, MT 59624.

IV. Authorship

18. Initial authorship -- Peter Lesica